BRANCH RIVER BRIDGE
Spanning Branch River (also known as
Otter Brook) at Main Street
Keene
Cheshire County
New Hampshire

HAER No. NH-21

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Northeast Field Area
Chesapeake/Allegheny System Support Office
National Park Service
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

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HISTORIC AMERICAN ENGINEERING RECORD

BRANCH RIVER BRIDGE HAER NO. NH-21

Location: Spanning Branch River, also known as Otter Brook, Main Street, City of Keene, Cheshire County, New Hampshire.

Quad: Keene Quadrangle

UTM: Zone 19, 722 700 E, 4755 350 N

Date of Construction: 1935

Engineer: New Hampshire Highway Department

Present Owner: City of Keene, Keene, New Hampshire

Present Use: Vehicular and pedestrian bridge

Significance: The Branch River is an excellent example of a widely used bridge type in New Hampshire, a concrete tee beam bridge. Within that category the bridge is unusual due to its continuous tee beams of variable section and significant length. The survival of its original concrete guard rails and the curved surface of the exterior fascia of the tee beams is also significant. Built in 1935 as part of a road widening and straightening U.S. Public Works Project, the bridge serves as a major connector on Route 12 from Keene center south to Swanzey. The road and crossing were in place as early as 1805.

Project Information: This documentation was undertaken in 1992 and 1993 in accordance with the Memorandum of Agreement prepared by the Federal Highway Administration, the New Hampshire State Historic Preservation Office, and the New Hampshire Department of Transportation and accepted by the Advisory Council on Historic Preservation as a mitigative measure prior to replacement of the bridge in 1993.

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1. Site Features and Historical Background

The Ashuelot Branch River Bridge spans the Branch River, a tributary to the Ashuelot River, which is in turn a tributary to the Connecticut River, in the city of Keene, New Hampshire. When this bridge was constructed in 1935, the Branch River was known as Otter Brook, and the bridge is known by both names in historical documentation. The bridge is located on Main Street, about one mile south of the city center and 0.76 miles northwest of the Keene-Swanzey town line. The city of Keene is located in the southwest corner of the state, about fifty-eight miles southwest of the state capital, Concord, and eighty miles northwest of Boston, Massachusetts.

Keene was first laid out in 1733 as Upper Ashuelot township, under the jurisdiction of Massachusetts, twenty miles from any established settlement. The first efforts at settlement were abandoned in 1747 and destroyed during the French and Indian Wars (McClintock 1880:556). Upper Ashuelot was rebuilt in the early 1750's, after the state border between New Hampshire and Massachusetts was clarified in the 1740's, and the town was chartered by the state of New Hampshire in 1753. The town included a large section of the town of Sullivan, which was set off in 1787, and the western portion of the town of Roxbury, which was incorporated in 1812 (Rand 1895:67; McClintock 1880:550,556). By 1767, the population had grown to 427 (McClintock 1880:550), and in 1771, Keene was made the county seat of Cheshire County.

Before 1800, nearly all the travel between the prosperous Connecticut River Valley and Boston passed through Keene town center, where five roads converged. The earliest route to Boston was the Third New Hampshire Turnpike, incorporated in 1799 (Anonymous 1805). This turnpike channeled the wealth of lower Vermont over the bridge on the Connecticut River at Bellows Falls through New Hampshire to Boston (Garvin 1988:52). Its route ran on a northwest-southeast axis through the town of Keene and its center (now largely the NH Route 12A, 101 and 124 corridors). Other roads leading out of Keene center were Pleasant Street, heading west to the town of Chesterfield (now Routes 9 and 12); Prison Street, which ran northeast to the town of Sullivan; and a road laid out on an easterly path from the town center over Beech Hill ("New Hampshire Town Maps of 1805)". Main Street was the only local road that carried traffic south from the town center over Beaver and then Otter Brooks. Near the Swanzey town line, Main Street branched; the west fork led to Factory Village in Swanzey, the right fork was known as the Old Branch Turnpike (Sturtevant 1850). The first recorded bridge over Branch River was constructed by the Turnpike and Branch Bridge Corporation in 1803; considering the early importance of South Main Street, it probably replaced an earlier one (Wadsworth 1932). A four-arch stone bridge was constructed at the site In 1839, at a cost of $2100 to the town. Its optimistic builders estimated that the bridge would stand no less than 1000 years; but it was replaced by the current concrete bridge 96 years later (Anonymous 1924:587). By 1820, the population of Keene was 1,895; in addition to residences, development in town included two meeting houses, twelve schoolhouses, six taverns, eight stores, nine saw mllls, four grist mills, two clothing mills, one carding machine, one tannery, a printing press and a bookstore (McClintock 1880:552).

Keene continued to serve as a transportation and commercial hub after the arrival of

the three railroad lines, lessening the need for roads for commercial and interstate traffic. The Cheshire Railroad opened from Fitchburg to Keene In 1848, connecting with Walpole, Bellows Falls and Montreal to the northwest and Marlborough, Troy, Fitzwilliam, Worcester and Boston to the southeast. The railroad's headquarters, repair shops and general office, all located in Keene, employed 250 residents (McClintock 1880:566). The Ashuelot Railroad linked Keene with Swanzey, Winchester, Hinsdale, Springfield and New York to the southwest. The Manchester and Keene Railroad ran east, connecting the city with Harrisville, Hillsborough, Concord and central New Hampshire (McClintock 1880:548).

In 1871, the Hampshire Pottery Company was established just north of the Branch River Bridge on the east side of Main Street, at the former site of the Milestone Mills clothespin factory. Blue clay deposits and white silicas were found nearby; and were also imported by rail from New York, and New Jersey (Pappas and Kendall 1971). Local brickyards were located to north off Appleton Street (Wadsworth 1895). The complex included a two-story, 160-foot long main building, a long wood shed and packaging storehouse (Sanborn 1884). The plant continued in operation until 1923, due to rising fuel costs and increased competition from potteries in New Jersey and Ohio (Pappas and Kendall 1971).

In the years after the Civil War, the town's population doubled to 6,786 in 1879, and a city charter was adopted 1874 (McClintock 1880:549). Encouraged by railroad transportation, ample water power and local lumber resources, the city's industries produced sleighs, harnesses, furniture, cloth, chairs, industrial machinery, bricks, wood products, toys, shoes, pottery and other products. Manufacturing continued to increase through the opening decades of the 20th century. Most of the commercial stores and offices were located north of the Branch River Bridge at Center Square or on the streets centering there. Keene was also a popular summer tourist destination, and in the late 19th century, three city hotels served patrons: the 100-room Cheshire House on the corner of Roxbury and Main streets; the 60-room Eagle Hotel on Main Street, and the 50-room City Hotel and boarding stable on Main Street (McClintock 1880:564). In 1895, the population numbered more than 8000, a sewer system and water lines had been installed, the fire department established, and concrete sidewalks and street crossings put down in the city center (Rand 1895:70).

As early as 1895, due to the availability of local granite,

> "Several of the principal thoroughfares have been macadamized, and a few short sections of streets are covered with granite pavement. The city owns an inexhaustible granite quarry, where a steam stone-crusher Is employed In preparing material for macadamizing purposes. It also owns a steam road-roller, whlch does effective work in the construction and repair of highways." (Rand 1895:70).

In 1903, the Keene Electric Railway was constructed, following the path of Main Street from Central Square south to Factory Village in Swanzey, on Marlboro Street to the village of South Keene, and on an east-west route along West Main and

Roxbury streets (Wadsworth 1903). A separate streetcar bridge was built over Branch River west of the stone arch bridge (Wadsworth 1932). A large parcel of land on either side of Branch River was designated the City Pasture, and a city incinerator and dump were installed on pasture land just north of the bridge (Wadsworth 1903). As many 193 loads of rubbish were disposed at the site on a weekly basis (Anonymous 1928). One of the most well-known photographs of Keene was taken at the site by Van S. Howes in 1893; a group of cattle stand in the shallow Branch River with the stone arch bridge as a backdrop (Anonymous 1973).

In the 1910's, with increasing automobile traffic, several state highways were named or reconstructed through the city of Keene. In 1915, Monadnock Road (now Route 12) was designated, beginning in downtown, over the Branch River Bridge, running south through Swanzey, Marlborough and Troy, ending at the Massachusetts state line. The route was extended in 1917, beginning at the what was then known as the South Side Trunk Line near the Cold River Bridge in Walpole and running south to downtown Keene. Other state highways in Keene dating from this period are the Cheshire Turnpike, from the Connecticut River in Chesterfield to Hillsborough (Route 9), dating from 1919, and the Dartmouth College Highway, from the Massachusetts state line through Winchester and several other towns to the Daniel Webster Highway in Carroll, laid out in 1923, also known as N.H. Route 10. The current Branch River Bridge was constructed by the state in 1935, as part of a U.S. Public Works Project to widen and straighten Route 12.

In 1921, the 140 foot wide Main Street in the business district was paved with reinforced-concrete, making it the widest paved street in New England (Chaplin 1922:85). Many of the city roads and bridges had been ill-maintained during World War I, and town reports from the 1920's are filled with highway improvements. The Portland, Maine, Construction Company laid 12,560 square yards of reinforced concrete pavement on Court, South Main and Main streets. The roadway was seven inches thick, one part Portland cement, two parts sand, and three parts crushed New Hampshire granite reinforced with steel mesh (Chaplin 1922:85). The use of local granite in the cement mixture opened a new market for the material. The Keene Superintendent of Highways predicted that

> "Concrete-granite roads improve with age; they do not deteriorate from age, wear and weather; they do not require costly maintenance... In my opinion this type of concrete-granite highway will positively arrest maintenance and its use on main highways will surely release funds now used for maintenance so that we can built more and better roads that are capable of meeting future requirements" (Chaplin 1922:87-88).

In 1928, 87 bridges and large culverts were located in the city of Keene; only the Branch River Bridge and a stone arch bridge on Court Street over the Ashuelot River dated from the 19th century (still standing) (Anonymous 1928). In addition to the two stone arch bridges, twelve other stone bridges, eight steel truss, five steel and tile pipe and concrete, forty-four concrete and steel, and eighteen wood bridges were located within the city boundaries (Anonymous 1928).

2. Bridge Description

The Branch River Bridge is a two-span continuous concrete tee beam bridge built in 1935. The two-lane bridge, aligned on a northwest-southeast access with a zero degree skew, is 122 feet long with a clear span length of 54'6" feet. There are no approach spans. The overall width is 34'4", and the roadway width is 24 feet between curbs, with an asphalt wearing surface. The bridge clears Branch River by 14 feet at the north span.

The two concrete cantilever abutments are identical, reinforced with steel two inches clear from the face of concrete, supported by 92 50 foot wood pilings in a base of fine sand. The abutments are 14 feet high, on three foot high footings, with an average width of 30 feet, topped with concrete caps. The wing walls return at a 90 degree angle, creating a U-shaped abutment. Expansion bearings are located at each abutment; at construction two layers of asbestos paper were laid on five bearing plates (15" X 3/4" X 1'6") to allow for expansion.

The one center solid pier is also constructed of reinforced concrete, 14 feet tall, on a three foot tall footing, supported by 49 wood pilings on a base of fine sand. The pier is topped with a 1'3" concrete cap. Two anchor bolts on five bearing plates fix each tee beam in place. An "ice nose," a pointed steel tip, is located on the east or upstream side of the pier.

The bridge's support system consists a five continuous reinforced concrete tee beams. The two 58 foot spans are identical. The beams vary in height from two feet at the center of each span to 4'11 1/4" at the abutments and 5'3 1/8" at the center pier. The beams are spaced 7'7" dead on center; they are 1'7" wide and flare to 2'7" wide beginning nine feet on either side of the center pier. The beams are reinforced with angled or "crank" bars under the wearing surface in the deck to distribute loads on the bridge (Moore 1993). 5/8" stirrups are utilized through the tee beams. The steel is only one inch clear on the crown roadway, due to that fact that corrosive salt was not used on snowy roads at the time of the bridge's construction (Moore 1993). Four rectangular drains are located at the edge of the roadway eight feet from each abutment and four more 15 feet from the center of the pier.

With the exception of the east and west tee beams, the top flange of the slab, the decking slopes from 8 1/2" in height to 7 1/2" high at the edge of the sidewalks. At construction, a wearing surface of 2 1/2" of asphalt was poured over the decking. The 5'2" wide concrete sidewalk on each side of the bridge is cantilevered with a one inch slope and nine inch rise above the wearing surface. The sidewalks were poured as part of the end tee beams, creating a heavier beam that can carry more dead load (Moore 1993). The sidewalks are edged with a 3'3" high reinforced concrete railing. The railing's six inch base was also cast Into the sidewalk. The railing is comprised of a series of 2'2" square posts, topped with a beveled seven inch cap. Rectangular newel posts are located above the abutments and piers. The four newel posts at the ends of the bridge were wired for electrical lamp stands that are shown in historical photographs. The lamps are no longer extant.

As early as 1941, the wearing course of the bridge showed wear, and the roadway was repaved regularly (Powelson 1993). The structural concrete proved a fairly constant maintenance problem, mainly due to the freeze and thaw action during New Hampshire winters. The DOT "red-listed" the bridge in 1982 due to deteriorating concrete in the deck and superstructure, and reinforced steel in the stringers was rusting. At its last inspection, the bridge received a federal sufficiency rating of 29 out of 100 (Powelson 1993).

3. Construction

In 1935, plans were made to widen a 1450 foot section of the Monadnock Highway, straighten two curves, and build a new bridge over Branch River on the new section of highway east of the four span arch stone bridge. The construction was funded by the U.S. Public Works Project. Judging from plans drawn by the State Highway Department, the old stone bridge did not interfere with plans for a new bridge, but was taken down anyway. In 1934, the city annual report noted that "There has been considerable work done on the Branch Road in resurfacing and grading, and there are two small obsolete bridges on this road that should be replaced as a matter of safety" (City of Keene 1934:8). The four span arch stone bridge had a width of 22 feet of clear roadway; the replacement bridge has a 24 foot wide roadway with 5'2" wide sidewalks.

The new bridge was designed by the state Highway Department under the direction of Harold E. Langley, assistant bridge engineer, and the supervision of John W. Childs, state bridge engineer. John H. Wells and "RDF" signed off on the plans in April 1935.

Bids for the project opened June 7, 1935. Nine companies responded to the request for proposals:

E.J. Cross Company of Worcester, Massachusetts, $44,716.30;
Arborio Road Construction Co. of Wilson, Connecticut, no amount;
Hagan-Thibodeau Construction Co. of Wolfeboro, New Hampshire, $45,351.30;
Littleton Construction Company of Littleton, New Hampshire, $46,875.94;
Simpson Bros Corp. of Boston, Massachusetts, $47,839.95;
Frank T. Westcott of North Attleboro, Massachusetts, $48,059.78;
The Lathrop & Shea Co. of New Haven, Connecticut, $51,202.68;
J.H. Ferguson Co. of Providence, Rhode Island, $51,452.25, and
Kittredge Bridge Company of Concord, New Hampshire, $58,556.59.

As the lowest bidder, E.J. Cross Company was awarded the contract. The end total cost of construction was $44,950.68.

4. Design and Technology

In the late 19th century, bridge engineers began to develop designs using reinforced concrete. As designers learned more about concrete and ways of strengthening it with iron and steel rods, they began using it with confidence and for increasingly

ambitious projects. The first American concrete bridge was built in Prospect Park in Brooklyn in 1871 and the first reinforced one in Golden Gate Park in San Francisco in 1889 (Jacobs 1968). Initially, reinforced-concrete bridges were similar in basic form to stone arch bridges, but gradually engineers began to develop more daring designs that differed in size, scale and form (Jackson 1988:35). Concrete is strong in compression, and steel provides tensile strength (Jackson 1988:35). By the turn of the century, reinforced concrete arches more than 100 feet long were being used in bridges (Jacobs 1968). Two early major systems of reinforcing were the Melan system of arches with iron truss reinforcing and the Ransome method, which was slightly more scientific utilizing bar reinforcing. Bridge innovator Daniel Benjamin Luten of Michigan introduced a system of a series of looped reinforcement bars about 1900 that was particularly useful in absorbing high impact loads on expanding highways during the first quarter of the 20th century.

Reinforced-concrete bridges became popular initially because they reduced maintenance and construction costs compared to steel. They made use of locally available materials such as sand, gravel and cement and can be built by relatively unskilled labor (Jackson 1988:38). Most large reinforced concrete bridges are either deck or rainbow arch structures. Reinforced concrete bridges proved even more economical with the development of multi-rib arches and open-spandrel arches for spans more than 100 feet in length. In addition, reinforced concrete arch bridges were often considered more attractive than steel truss and built on highways or fashionable urban areas (Jackson 1988:38). Continuous or cantilever bridges were designed to economically bridge long distances between piers by extending beyond the piers. Cantilever bridges are built using a large number of relatively small members. Visually, they usually differ from their simple counterparts in that the beams get deeper or taller where they pass over the piers in order to resist large bending stresses in these locations (Jackson 1988:31).

In 1988, a thematic review of reinforced concrete tee beam bridges in New Hampshire was completed by staff members from the New Hampshire Department of Transportation, State Historical Preservation Office and the Federal Highways Administration. The committee determined that the Branch River Bridge was built in the "Mature Flourishing Phase" of tee beam construction in the state, from 1928 to 1939, and was in original condition. The bridge was considered unusual because of being continuous with tee beams of variable section of significant length (two 54'6" clear spans). The survival of its original concrete guard rail and the curved surface of the exterior fascia of the tee beams were also determined unusual. Although judged to be a common survivor in New Hampshire, the bridge was considered to be an excellent example of a widely used bridge type. The bridge received the third highest rating by the committee and is potentially eligible for the National Register of Historic Places.

HISTORIC AMERICAN ENGINEERING RECORD

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APPENDIX I

Site Plan